Exchange Rate Regime: Does it Matter for Inflation?

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This paper investigates the link between exchange rate regimes and inflation performance in developing countries. De facto classifications of exchange rate systems are first obtained by using different methodologies to assess the volatility of the observed nominal effective exchange rates. The empirical work on the linkage between exchange rate regimes and inflation is then undertaken by developing and estimating an expanded version of the conventional Philips curve model. Two major conclusions are reached on the basis of our results: (1) the rate of inflation is unambiguously positively linked to real exchange rate depreciation regardless of exchange rate arrangement and, more specifically, (2) that the rate of inflation is much more responsive to the real exchange rate levels in the flexible rate systems than in the fixed regimes, suggesting that the former regime is more inflationary.

INTRODUCTION

Since the breakdown of the Bretton Woods and the resulting uncertainty regarding what represents an appropriately valued currency and how it can be achieved, the economic performance of many developing countries has been greatly challenged. The importance and degree of what is at stake is evidenced by the wide variety of exchange rate regimes adopted by different countries, ranging from fully pegged to fully flexible – with a broad array of intermediate systems. The logic behind the search for the "right" exchange rate regime is that it matters for economic performance such as inflation and output. In fact, the impact of inflation on economic growth and other macro variables is a serious concern that warrants economic policies to ensure their stability.[1]

The economic and social costs of inflation, and the emerging view that even moderate rates of inflation are harmful to economic efficiency and growth, generated a renewed interest for a need to design sustained and more prudent strategies to secure a reasonable rate. While inflation targeting policies have been adopted by a number of industrialized countries (including Canada, New Zealand, United Kingdom, Finland, Sweden) to address the inflation problem, the question remains if a pegged exchange rate regime may be the answer for developing countries. In fact, the adoption of an exchange rate regime has been found to be a critical ingredient for successful macroeconomic performance in developing countries. Such a decision – to float or to fix the exchange rate - by policymakers is complicated by the inflation-output tradeoff involved and the theoretical and empirical evidence that makes it difficult to establish a clear relationship between exchange rate arrangements and economic performance.

In this paper, we investigate some of the factors that drive inflation in developing countries. Specifically, we analyze the link between the choice of exchange rate regime and inflation performance, arguing that fixed (or pegged) exchange rate regime, through powerful constraints it imposes on domestic policy actions, leads to a discipline and credibility effects and, therefore, lower inflation. Flexible exchange rate regime, on the other hand, affords freedom of actions and monetary growth under the regime is much more accommodative of inflation.

The paper goes beyond previous studies in two important respects. First, it uses a larger data sample from most developing countries in Africa, Asia, and Latin America. Second, and most importantly, it goes beyond the traditional dichotomy that classifies exchange rate regimes as either "fixed" or "floating" based on the publicly declared or stated intention of the central bank authorities (*de jure* classification). Since central banks do not necessarily do what they say they do, the official (*de jure*) exchange rates might differ (and sometimes significantly) from the ex ante (*de facto*) rates. To account for that discrepancy, the analysis in this study is based on the *de facto* measures of exchange rates, which may provide better information in explaining inflation performance.

INFLATION PERFORMANCE: FIXED VERSUS FLEXIBLE EXCHANGE RATE REGIMES

The emerging and challenging view that even moderate inflation is harmful to economic efficiency and growth lends support to policies that seek to control and maintain low and stable inflation. One of those strategies is the choice of exchange rate regime. Since the early 1970s, the choice of exchange rate regime has aroused considerable interest due to the macroeconomic effects (especially on inflation and output) of an exchange rate regime. Although a number of studies link inflation performance of a country to its foreign exchange rate regime (fixed or flexible), the theoretical and empirical literature suggests a rather mixed record, and that no systematic relationship exists between inflation and exchange rate regimes.

A fixed or pegged exchange rate regime may be defined as one in which the external value of the currency is maintained within a narrow margin of parity. As such the regime limits the authorities' ability to use exchange rate changes as a policy instrument to address external disequilibrium. It is therefore generally argued in favor of fixed or pegged regime that it creates a "discipline" and "credibility" to the system. As Williamson (1974) put it, credibility in par value provides stability to the market and thereby reduces uncertainty, compared to a system with no declared reference value. In fact, a pegged exchange rate regime has the potential to affect inflation in two ways: by instilling monetary discipline and by altering the relationship between money and prices [Bleaney and Fielding (2000)].

The reasons typically cited for a pegged exchange rate as an anti-inflationary tool is well summarized in Ghosh et al. (1996). First, a pegged regime provides a highly visible commitment (in terms of prudent monetary and fiscal policy) and thus raises the political cost of abandoning the peg. Second, insofar as the peg is credible, it engenders a greater demand for the domestic currency, which reduces the inflationary consequences of a given expansion in the money supply. According to the authors, the inflation performance is therefore generally better under pegged regimes with annual inflation rate of 8 percent compared with 14 percent for intermediate regimes, and 16 percent for countries with floating regime. An even more compiling case (but may be a problem!), is the evidence from the CFA franc zone. According to Reinhart and Rogoff (2002) these countries, despite the relatively high degree of exchange rate stability they enjoyed, constitute the region of the world that has experienced by far the most frequent bouts of deflation - about 28 percent of the time (on average) for the period 1970-2001. A pegged regime by providing a clear and transparent nominal anchor has the role of communicating to the public the monetary authorities' commitment to prudent and sustained monetary policy and low inflation target. Contrary to a flexible regime, a policy that commits to fixing the exchange rate will be viewed as a clear abandonment of discretionary policy, Clerc et al. (2008) and Engel (2009).

By constraining the monetary authorities' use of the inflation tax as a source of revenue, a credible pegged regime provides an atmosphere that tie down private sector expectations of inflation, IMF (1997). According to the later, the lower inflation associated with a pegged regime, is perhaps a reflection of the

greater policy discipline imposed by the regime. Even a pegged exchange rate country with an initially high inflation will eventually, through the discipline effect, enjoy a low inflation rate. Under a pegged regime, a high inflation relative to the country's trading partners, will results in a balance of payments deficits and a loss of international reserves. Insofar as the exchange rate cannot be used to restore the external disequilibrium, the country will ultimately have to discipline itself through other contractionary policies such as aggregate demand policies, commercial policy, or exchange control [see Crockett and Goldstein (1976) for more details]. A floating exchange rate regime lacks the discipline effect such that a balance of payments deficit as a result of a high domestic inflation can be exacerbated by the depreciation of the (market-determined) exchange rate that resulted from the inflation.

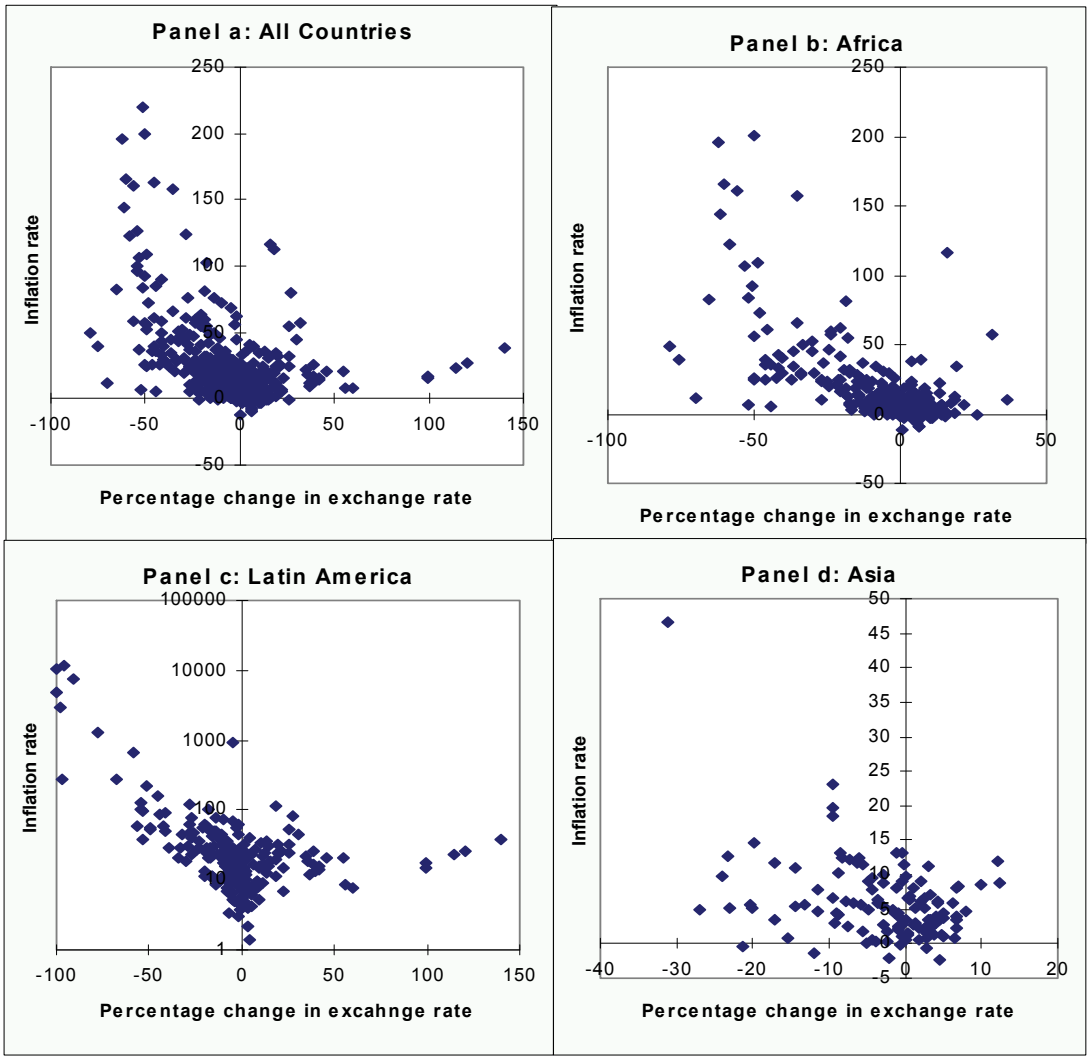
Using annual data from 1964 to 1998 for 53 developing countries, Loungany and Swagel (2001) found that while inertia factors dominate the inflation process in developing countries with fixed exchange rate regimes, monetary growth and exchange rate changes are far more important in countries with floating exchange rate regimes. For Bleaney (1999), the most consistent finding since 1973 is that pegged exchange rate regimes are associated with inflation rates at least 10 percent a year lower than floating exchange rate regimes, after allowing for other factors.

The discussion so far may lead one to believe that the inflation effect of exchange rate regime is black and white and that pegged regimes are less inflationary than the systems of floating rates. Arguments in favor of pegged regimes usually center on the discipline and credibility the system creates. Simple declaration of a pegged exchange rate, however, is not an end in itself and is insufficient to provide the system with all its intended benefits. The anti-inflationary benefit is heavily dependent on the monetary stability and credibility of the regime, which need to be carefully built in a well-functioning economy. The credibility gain is not a free lunch but requires the adoption of fiscal (and thus monetary) policies consistence with the maintenance of the peg, Ghosh et al. (2002). As Calvo (1993) points out, a lack of credibility may be more destructive under fixed exchange rates than under floating rates because real disruptions are magnified. The discipline argument of the pegged regime assumes that the exchange rates are permanently fixed or that the use of the exchange rate as a policy instrument is very unlikely. However, if the fixed exchange rate is frequently altered in the attempts to correct imbalances in the economy, it could well be more inflationary than the system of floating rate. Corckett and Goldstein (1976) argue that although flexible rates generates somewhat greater exchange rate uncertainty than do fixed rates, this type of uncertainty is no worse than the other types of uncertainty involved in trying to maintain a fixed rate.

In IMF (1997), it is claimed that in a pegged regime, the inflationary cost of not adjusting to fiscal imbalances may not be immediately apparent, but shifted into the future by allowing international reserves bear the strain or external debts to accumulate until the peg can no longer be sustained. In a flexible exchange rate regime, however, the costs may be revealed more quickly through the (market-determined) exchange rate and price movements, provided that markets correctly assess the situation. It is therefore argued that flexible exchange rates may exert a stronger discipline on policies than fixed rates.

Friedman (1953) noted that, due to the inability of the monetary authorities to use the exchange rate as policy instrument to correct macroeconomic imbalances in a pegged system, the substitution of flexible for rigid exchange rates may not change the extent of uncertainty at all and, indeed, may even decrease it. Contrary to the heavy cost created by the adherence to the discipline in the pegged system, proponents of flexible rates stress the flexibility afforded by the regime that enables the monetary authorities to respond quickly to unforeseen and fundamental disturbances. Given that foreign exchange rate is one of the most important prices in an economy, misaligned exchange rate, even for a short run, can come at heavy costs for the economy. As Quirk (1994) puts it, because exchange rate can be such a useful indicator, even fixed exchange rate regimes should allow sufficient short-run and medium-term flexibility to deal with shocks that are not reversible. The opportunity to manage the exchange rate under flexible regime, allows frequent independent policies to counteract unexpected shocks to the economy so as to reduce any uncertainty related to sharp and severe adjustments as are possible in the case of a pegged rate system.

FIGURE 1
EXCHANGE RATE VOLATILITY AND INFLATION



There is evidence suggesting, however, that inflation is persistent and higher under floating regimes than under pegged rates. Evidence is also obtained that monetary policy is more accommodative of inflation under floating rates, Alogoskoufis and Smith (1991), Obstfeld (1995), Dornbusch (1982). Liu and Adedeji (2000) found that an excess money supply generates an increase in the rate of inflation that, in turn, reduces the real demand for domestic money in favor of foreign exchange, thereby exerting pressures on the foreign exchange market. It is also generally argued that monetary accommodation of inflationary shocks will affect the expectations of forward-looking wage and price setters which, through the wage-price spiral, will result in an increase in the persistence of such shocks. Another argument generally advanced to support the idea of higher inflation under floating rate regime, is the high cost the regime entails as a result of the greater exchange rate uncertainty. The unpredictable nature of exchange rates under flexible regimes forces risk-averse economic agents to insure themselves against the exchange rate risk at a cost that would not have existed should the exchange rate be fixed or fairly predictable. The *ratchet* effect also predicts higher inflation as a result of higher and frequent exchange rate volatility. The argument holds that in a world of downward price inflexibility, devaluations (or depreciations) cause higher price increase than overvaluations of the same size reduce prices. Therefore, in a floating regime,

the higher and more frequent exchange rate fluctuations will have serious upward pressures on the overall price level even if the mean value of the exchange rate remains unchanged [See Crockett and Goldstein (1976) for more details].

The higher-inflation argument of exchange rate volatility is apparent in Figure 1 (above). Except for Asia, the data show that higher nominal effective exchange rate depreciation (volatility) is associated with higher inflation. The surge in inflation in many Latin American countries following large devaluations in the 1980s reinforces the non-neutrality of inflation regarding exchange rate volatility. The particularity of the Asia experience is also revealed in Kamin (1997) where the author found that the response of inflation to devaluation was relatively subdued.

In Crockett and Goldstein (1976) that evaluated the arguments and counter-arguments of the inflation effects of alternative exchange rate regimes, the authors claimed that it is hard to escape the overall conclusion that the type of exchange rate system has relatively little influence on the average rate of world inflation. They however noted that, based on a priori plausibility and past experience, there appears to be evidence for supposing that flexible exchange rates are more inflationary than fixed rates. Ghosh et al. (1996) on the other hand, found a strong link between the choice of exchange rate regime and macroeconomic performance. They found that flexible exchange rates are more inflationary, but are associated with a slightly faster per capita GDP. In a similar vein, Bleaney (1999) reported that shifting from pegged to floating exchange rate is predicted to add at least 10 percent to a country's inflation rate. In IMF (1997), it is also found that although the difference has narrowed substantially in the 1990s, inflation in countries with flexible exchange rates has been consistently higher and more volatile than in countries with pegged rates.

The impact of exchange rate regime on inflation is actually more ambiguous than has been presented in our analysis so far. Aghevli et al. (1991) found evidence that the average rate of inflation was lower in countries with pegged exchange rates than in countries with floating rates, but noted that many of the countries with pegged rates have experienced higher inflation as a result of a lack of adherence to appropriate fiscal policies. On the other hand, many countries with floating exchange rates recorded desirably low inflation by adopting prudent fiscal policies. Evidence indicate that economic growth can be satisfactorily high and inflation desirably low, under either pegged or flexible exchange rate regimes provided that appropriate policies and other conditions for good economic performance are in place (IMF, 1997). Siklos (1996) argue that, because of the lack of credibility, countries with fixed exchange rate often experience higher rather than lower average inflation rate. In a study in which he compared average inflation rates for ten countries that switched regime, Corden (1993) found that in three cases the average rate had been markedly higher, suggesting a loss of disciple as a result of the switch to the flexible regime. In the other seven cases however, there does not appear to have been a loss of discipline.

Given the arguments and counter-arguments presented so far, and as pointed out by Klau (1998), the inflationary and output effect of exchange rate regimes remains open and depends on the supply shocks to which the countries are exposed and on the domestic monetary and fiscal policies the countries have adopted. The evidence to date can be better described as mixed.

THE MODEL AND EMPIRICAL RESULTS

Exchange Rate Regimes Classifications

In the previous discussions, we explored the possible linkages between inflation and alternative exchange rate regimes. The analysis was framed in a way that suggests the traditional dichotomy according to which an exchange rate regime can either be classified as fixed or flexible. The International Monetary Fund (IMF) classification based on the member countries' self-declared regimes, however, spans exchange rate regimes ranging from "dollarization", currency boards and traditional pegs, to float with discretionary intervention and pure float. This official or "*de jure*" classification poses the obvious problem of how a country's exchange rate regime should be classified. More importantly is whether the *de jure* classification reflects the actual country practice. Although a full coverage of these problems are beyond the scope and aim of this paper, the methodology for classifying regimes needs at least be

addressed before undertaking any empirical work on the linkage between exchange rate regimes and inflation.

The main problem stems from the fact that the *de jure* classification, published in the *IMF's Annual Report on Exchange Rate Arrangements and Exchange Restrictions*, often fails to capture the actual behavior of countries' exchange rates movements. Although the *de jure* classification stresses the stated policy intention of the monetary authorities, if the later fail to do what they say they do, the observed exchange movements may widely diverge from the officially-declared expected movements, Calvo and Reinhar (2002), Levy-Yeyati and Sturzeneger (2005), Wickham (2002). A fixed exchange rate regime in which the rate is frequently altered by the authorities should rationally be classified as a form of a float. Likewise, if heavy government interventions in a system of floating rate or shocks to the system, lead to relatively stable exchange rates, the officially-declared regime may be profoundly misleading.

It is not unusual for some governments to pursue expansionary policies under fixed regimes, thereby abusing the credibility benefits of the regime, Tornell and Velasco (2000). In a study that re-classifies historical exchange rate regimes based on the observed exchange rate movements, Reinhart and Rogoff (2002) found that when the official categorization is a form of peg, roughly half the time their classification reveals the true underlying monetary regime to be something radically different, often a variant of a float. When the *de jure* classification is a float, their results routinely suggest a form of a peg. For Levy-Yeyati and Sturzenegger (2005), only few more than 30 percent of the self-declared floating rate countries behave as such. Moreover, according to Carrera and Vuletin (2002), while 62 percent of *de jure* flexible regimes behave as such, just 39 percent of the fixed do so. Given this pronounced inconsistency between the official (self-declared) exchange rate regimes and the observed behavior in practice, empirical work on the impacts of exchange rate regimes requires a new classification based on the actually observed exchange rate movements - a *de facto* classification. For instance, in Dubas et al. (2005), an econometric procedure to obtaining *de facto* exchange rate regime classifications was used and applied to study the relationship between exchange rate regimes and economic growth.

Although each classification - *de jure* or *de facto* - has its own advantages and drawbacks, the empirical work in our paper is based on the *de facto* classification of exchange rate regimes. To this end, different methodologies are used to assess the volatility of the observed nominal effective exchange rates: standard deviation of monthly effective exchange rates in each year, annual percentage change of effective exchange rates, and a classification based on "z scores". The later draws from Ghosh et. al. (1997). The "z" value computed for each country and each sample year reflects an annual score based on the mean and variance of the monthly depreciation rates:

$$z = \sqrt{\mu_{\Delta e}^2 + \sigma_{\Delta e}^2}$$

where $\mu_{\Delta e}$ is the average monthly rate of change of the nominal effective exchange rate during the year, and $\sigma_{\Delta e}$ is the variance of those monthly changes.

For the following analyses, a three-way classification of the foreign exchange rate data is used: "fixed", "intermediate", and "flexible". For each country, each measure of foreign exchange rate volatility aforementioned is used to determine the volatility of the observed nominal effective exchange rate in a given year. If the volatility of the rate is less than ±2% in the year, then the rate is ruled as "fixed" for that year. If the volatility is above ±5% in the year, then the rate is considered flexible for that year. Exchange rate volatilities that fall within ±2% and ±5% are considered as "intermediate" arrangement.[2] The classifications - fixed, intermediate, and flexible - obtained from each volatility measure is experimented with, and only the ones that best fit the data are considered in the estimations below.

The Model

It is apparent from our previous discussions that little consensus exists at the theoretical as well as empirical levels about how exchange rate regimes affect macroeconomic variables, in particular inflation and growth. The general acceptance today that the key objective of monetary policy should be to deliver

low inflation has aroused considerable interest in understanding the driving forces behind the behavior of general price levels. In this section, we intend to identify and quantify the sources of inflation in developing countries, focusing particularly on the effects of exchange rate regimes.

Although the details of the linkage are less unequivocal, inflation is generally said to be a monetary phenomenon. In fact, traditional monetarists support the strict view that non-monetary factors are irrelevant in determining inflation. According to the P^* model that tends to revive the traditional monetary view, inflation results from monetary growth (especially M2), and demand and supply shocks have no roles in explaining inflation. In criticizing the pure monetarist view, Kuttner (1990) noted that although some measure of money (possibly M2) may be the main determinant of inflation in the long run, it does not follow that *only* money matters in determining inflation over all horizons. Christiano (1989) on the other hand, failed to turn up any convincing evidence that the P^* model far outperforms other models as an inflation forecaster. Moreover, a number of empirical studies show that the sources of inflation are quite diverse in developing countries and include the following:

(i) Fiscal imbalances: This approach links inflation to public sector deficits, Rodrik (1991), Montiel (1989), Bruno and Fischer (1990). Given the limits on domestic and foreign borrowing, monetization is the residual form of deficit financing, Lim and Papi (1997). The authors find that monetary variables (initially money, more recently the exchange rate) and public sector deficits play a central role in the inflationary process. For Loungany and Swagel (2001), the fiscal variables of money growth and exchange rate changes are far more important in explaining inflation in countries with floating exchange rates.

(ii) Output gap: The approach posits that a deviation of an economy's actual output from its potential level as a result of an excess demand in an overheated economy will lead to inflation. On the other hand, a positive supply shock is likely to result in lower inflation pressures, Callen and Chang (1999), Chand (1996), and Coe and McDernott (1997).

(iii) Economic structure and supply-side cost shocks: These sources of inflation include openness to trade [(Romer (1993), Lane (1997)), central bank independence [Alesina and Summers (1993)], markup pricing in oligopolistic industries, energy shocks, taxes, and price controls. Bjornland (2000) noted that in a small economy, a large part of inflation is imported. Blejer and Leiderman (1981) claimed that in an open economy, there is a strong presumption that domestic relative price variability will be influenced by foreign relative price volatility. The authors also stressed the support by various studies of the non-neutrality of the inflationary process with respect to the structure of the domestic relative prices.

(iv) Inflation inertia according to which inflationary shocks may translates into higher inflation expectations through wage and price contracts, which in turn materialize in terms of higher actual inflation, Kamin (1997), Lim and Papi (1997), and Loungani and Swagel (2001).

To address the question as to whether pegged (floating) exchange rate regimes are anti-inflationary (more inflationary), we derived a model that helps quantify the contribution of the exchange rate regime component of inflation. The theoretical approach is adopted from the analytical framework developed in Kamin (1997). The model assumes a small open economy that produces, consumes and exports a home good (d), and imports and consumes a foreign good (f). The domestic price of the foreign good (P_f) is determined by the exchange rate E (local currency per unit of foreign currency – an increase indicates depreciation) and the exogenous foreign currency price of foreign goods (P_f^*) such that:

$$P_f = E P_f^* .$$

The domestic good price (P_d) on the other hand is determined by equilibrium in the domestic good market. It is hypothesized that domestic good prices respond to the gap between the actual and equilibrium real exchange rate according to the following partial adjustment process:

$$\Delta \log P_{d,t} = \lambda \log(P_f / P_d)_{t-1} - \log(\bar{P}_f / \bar{P}_d)_{t-1} \quad (1)$$

where (P_f / P_d) and $(\bar{P}_f / \bar{P}_d)$ are the actual and equilibrium real exchange rates, respectively (an increase of the real exchange rate indicates depreciation).

The empirical challenge is that the equilibrium real exchange rate (RER) is not observable. The theoretical and empirical studies that addressed the problem posit that, contrary to the purchasing power parity approach, the equilibrium RER is not an "*immutable number*", but responds to its *fundamental* variables. Kamin hypothesized that the equilibrium RER is the value of the real exchange rate consistent with the equilibrium condition in the domestic goods market. The log-level of the equilibrium RER is expressed as a simple negative function of the log-level of the ratio of the domestic absorption (A) and potential output of the domestic economy ($\bar{Y}$):

$$\log(\bar{P}_f / \bar{P}_d) = \psi - \varepsilon \log(A / \bar{Y}) \quad (2)$$

where $(\bar{P}_f / \bar{P}_d)$ is the equilibrium RER, ψ is a constant, and ε is positive and depends on the elasticity of demand (and supply) with respect to the equilibrium RER.

Substituting equation (2) into equation (1) and rearranging terms, yields:

$$\Delta \log P_{d,t} = -\lambda\psi + \lambda \log(P_f / P_d)_{t-1} + \lambda\varepsilon \log(A / \bar{Y}) \quad (3)$$

Equation (3) indicates that the rate of change in domestic good prices is determined by the discrepancy between the absorption and potential output in the domestic market, and real exchange rate misalignment (in terms of deviations of the actual from the equilibrium real exchange rates).

A minor problem with the formulation in equation (3) is that it depicts the inflation dynamics for home good prices, while available inflation data are for consumer price inflation. It is assumed that consumer price inflation - a weighted average of home and foreign goods inflation - is represented as follows.

$$\Delta \log P = \alpha \Delta \log P_d + (1-\alpha) \Delta \log P_f \quad (4)$$

Additionally, given that the multilateral real effective exchange rate (log of RER) is a function of the log of the ratio of foreign to domestic prices, it is expressed as follows:

$$RER = \frac{P^* E}{P} = \frac{P_f}{P_d^{\alpha} P_f^{1-\alpha}} = \left(\frac{P_f}{P_d}\right)^{\alpha} \quad (5)$$

Substituting the expressions for the domestic good prices and the ratio of foreign to domestic prices (equations 3 and 5, respectively) into equation 4, yields:

$$\Delta \log P_t = -\alpha\lambda\psi + \lambda \log RER_{t-1} + \alpha\varepsilon\lambda(\log A - \log \bar{Y})_{t-1} + (1-\alpha)\Delta \log P_t^* + (1-\alpha)\Delta \log E_t \quad (6)$$

Before confronting the model with the data, two additional assumptions need to be made. First, due to the lack of (quality) data on absorption, actual real GDP (Y) is used as a proxy for absorption (A).

Second, to account for inflation persistence, as is suggested in many other studies, a lagged dependent variable is included. The final estimating equation, taking into account the last two assumptions, is expressed as follows:

$$\Delta \log P_t = -\alpha\lambda\psi + \lambda \log RER_{t-1} + \alpha\varepsilon\lambda(\log Y - \log \bar{Y})_{t-1} + (1-\alpha)\Delta \log P_t^* + (1-\alpha)\Delta \log E_t + \beta \Delta \log P_{t-1} \quad (7)$$

An important feature of this Kamin model is that it represents an expanded version of the conventional Philips curve model which abstracts from open economy considerations. In the case of a country having close trade links with the rest of the world, part of the domestic inflation is imported as the domestic price is influenced by foreign price volatility. The Kamin model however omits some widely-believed determinants of inflation such as monetary and fiscal policy variable, degree of openness, and central bank independence. Some of these variables (such as money growth) as Kamin explained, impact inflation through its approximate determinants, the exchange rate and absorption. While this argument is somewhat convincing, an attempt is however made to estimate our model with and without those variables for comparison purpose.

Empirical Results

Equation 7 was estimated using pooled annual data for the period 1985-2006. Specifically, the equation was confronted with data under different scenarios: fixed and flexible exchange rate regimes[3], by region (Africa, Asia and Latin America), and all countries together. For each scenario and to control for endogeneity problem, ordinary least squares (OLS) and Instrumental Variable (IV) estimations were used.[4] The data are from the World Development Indicators (World Bank) and the International Financial Statistics (International Monetary Fund).

Table 1 presents the results of inflation regressions with respect to fixed and flexible exchange rate regimes. The results corroborate the theoretical discussions above and, for few exceptions, the coefficients are correctly signed and statistically significant. First of all, it emerges from Table 1 that past inflation and foreign inflation are positively correlated with contemporaneous inflation, irrespective of exchange rate regime. The coefficients of the two variables (Inflation Lag and Foreign Inflation) are positive and statistically significant. The coefficients of the foreign inflation variable are significantly higher under the flexible exchange rate system, while the coefficients of the lagged dependent variable are lower under that regime, suggesting a low degree of inflation persistence. The lack of monetary stability and credibility of the flexible system provides an environment of heighted uncertainty and fear of inflation that should, at least theoretically, generates a high coefficient for the lagged price changes in the flexible rate systems as compared to the fixed regimes. On the other hand, it can be argued that a lack of credibility (and for many other reasons aforementioned) may be less destructive under flexible exchange rates than under fixed rates because real disruptions are magnified under the latter, Calvo (1993). As such, uncertainty and fear of inflation in either regime may be, at least, equally detrimental in both. In fact, and as we will see later, the coefficients on the lagged dependant variable in Table 2 are roughly similar under the two regimes.

Inflation performance is also influenced by the country's external terms of trade and its openness to the rest of the world. The openness variable is correctly signed and significant under the two exchange rate regimes, supporting the view expressed in other studies, Romer (1993), Lane (1997), Wynne and Kersting (2007), and Gupta (2007). The terms of trade variable is also negative as expected but only significant under the fixed exchange rate regime. The output gap coefficient has mixed signs and is statistically insignificant across all specifications. Empirical difficulties in estimating the output gap variable may explain its statistical insignificance.[5]

TABLE 1
EMPIRICAL RESULTS FOR INFLATION MODEL BASED ON EXCHANGE RATE CLASSIFICATIONS
(Dependent Variable: $\Delta \log P_t$)

Variables	Fixed				Flexible			
	OLS		IV		OLS		IV	
	1	2	1	2	1	2	1	2
Constant	32.82	47.61	33.30	45.20	129.74	142.41	129.21	142
	(3.77)	(5.32)	(3.29)	(4.40)	(8.07)	(8.37)	(7.88)	(8.18)
Inflation Lag	0.33	0.33	0.32	0.32	0.17	0.16	0.17	0.16
	(12.75)	(12.86)	(10.13)	(10.79)	(4.99)	(4.68)	(4.99)	(4.66)
Foreign Inflation	1.26	1.44	1.12	1.30	2.93	2.68	2.86	2.69
	(4.69)	(5.56)	(3.54)	(4.25)	(3.80)	(3.48)	(3.25)	(3.07)
Nominal Devaluation	0.63	0.52	3.15	2.81	0.55	0.44	0.53	0.56
	(2.19)	(1.89)	(3.04)	(2.43)	(7.24)	(7.40)	(3.75)	(3.97)
REER	0.16	0.23	0.16	0.21	0.60	0.64	0.59	0.64
	(3.60)	(5.07)	(3.05)	(4.13)	(7.56)	(7.92)	(7.16)	(7.54)
YGap	-0.18	-0.01	-0.26	-0.11	-0.04	0.02	-0.04	0.02
	(1.18)	(0.09)	(1.43)	(0.59)	(0.12)	(0.05)	(0.12)	(0.05)
TOT		-14.70		-21.20		-6.40		-6.40
		(1.97)		(2.33)		(0.4)		(0.40)
Openness		-0.02		-0.02		-0.05		-0.05
		(4.21)		(2.44)		(2.14)		(2.13)
R^2	0.55	0.59	0.40	0.47	0.48	0.50	0.48	0.50
DW	2.00	1.98	1.73	1.74	1.54	1.54	1.54	1.54
No. Obs.	231	231	231	231	157	157	157	157

Note: t-statistics in parentheses; Nominal effective exchange rate: an increase indicates depreciation; Real effective exchange rate (REER): an increase indicates depreciation.

We now turn to the (nominal and real) exchange rate variables. It is clear from our results in Table 1 that nominal exchange rate depreciation increases domestic price level in the two exchange rate systems. Apart from the IV estimation for fixed rate system where the coefficients are surprisingly higher, the other estimation coefficients of the nominal devaluation variable are similar in the two exchange rate systems. Regardless of exchange rate arrangement, nominal exchange rate depreciation increases the domestic price of internationally-traded goods and put upward pressure on the general domestic price level. Additionally, the impact of nominal currency depreciation on domestic inflation depends on the degree of openness of the country and the response of foreign suppliers and local distributors to the devaluation. The results show that these factors have similar impact in the exchange rate pass-though process in the two currency regimes.

Of particular interest in our investigation is the coefficient of the real exchange rate variable. The results reveal that inflationary process is responsive to real exchange rate in the two regimes. The coefficient of the real exchange rate variable is negative and statistically significant across the two regimes and different specifications. More importantly, the results obtained from the analyzes clearly indicate that the responsiveness of inflation to the real exchange rate level is much more pronounced in flexible rate systems than in the fixed regimes, as shown by the larger coefficient on the real exchange rate variable under that regime. This suggests that flexible exchange rate regimes are more inflationary than pegged (fixed) exchange rate regimes. Similar conclusions were reached by Klau (1998) for CFA franc and non-CFA countries and Kamin (1997) for Asia, Latin America and industrial countries. In the

same vein, Bleaney and Francisco (2005), Bleaney and Fielding (2002), Domac et al. (2001), and Ghosh et al. (1996), confirm that hard pegs reduce inflation in developing countries. In light of these results, it is not surprising why countries besieged by increasingly high inflation resorted to a pegged exchange rate as a central element of stabilization programs.

TABLE 2
EMPIRICAL RESULTS FOR INFLATION MODEL BASED ON DUMMY VARIABLES
(Dependent Variable: $\Delta \log P_t$)

Variables	All countries				By Region		
	OLS		IV				
	1	2	1	2	Africa	Asia	Latin America
Constant	75.40	85.35	74.82	85.47	22.83	48.24	117.61
	(9.43)	(10.60)	(9.26)	(10.49)	(2.31)	(5.24)	(5.14)
Inflation Lag	0.27	0.26	0.27	0.26	0.40	0.26	0.28
	(12.64)	(12.49)	(12.61)	(12.49)	(13.19)	(3.40)	(5.75)
Foreign Inflation	1.28	1.43	1.16	1.45	1.21	1.50	2.43
	(4.35)	(4.94)	(3.26)	(4.12)	(3.90)	(4.78)	(4.17)
Nominal Devaluation	0.49	0.50	0.40	0.52	0.99	0.73	0.43
	(8.92)	(9.39)	(2.55)	(3.34)	(16.89)	(6.68)	(4.86)
REER	0.34	0.38	0.34	0.39	0.10	0.24	0.54
	(8.69)	(9.77)	(8.35)	(9.52)	(2.16)	(5.23)	(4.85)
YGap	-0.34	-0.20	-0.35	-0.19	-0.22	0.31	-0.30
	(2.20)	(1.27)	(2.26)	()1.24	(1.28)	(2.15)	(0.68)
Dummy Fixed	-3.02	-2.32	-3.07	-2.31			
	(3.09)	(2.41)	(3.13)	(2.38)			
Dummy Flexible	5.97	5.54	6.44	5.47			
	(5.12)	(4.85)	(4.58)	(3.95)			
TOT		-15.72		-15.77	-12.51	11.24	-47.31
		(2.11)		(2.11)	(2.03)	(0.97)	(2.22)
Openness		-0.03		-0.03	-0.02	-0.02	-0.05
		(4.69)		(4.66)	(1.07)	(3.98)	(3.19)
R^2	0.53	0.56	0.53	0.56	0.74	0.55	0.61
DW	1.98	1.96	1.97	1.97	2.01	1.84	1.39
No. Obs.	499	499	499	499	228	114	137

Note: t-statistics in parentheses; Nominal effective exchange rate: an increase indicates depreciation; Real effective exchange rate (REER): an increase indicate depreciation.

To substantiate our preceding claim that flexible rate regimes are more inflationary and to quantify inflation differentials in the different exchange rate systems, equation 7 was re-estimated using the full sample (all countries) data with dummy variables representing the different systems. The data is classified in three exchange rate systems: fixed, intermediate, and flexible. Dummy variables were included for the fixed (Dummy Fixed) and flexible (Dummy Flexible) systems, with the intermediate regime as the excluded category. As such, negative coefficients of the dummies indicate lower average inflation in comparison with intermediate regime, while positive coefficients denotes higher inflation with respect to the intermediate regime.

The results of the estimations, reported in Table 2, strongly corroborate our previous finding that exchange rate regime matters for inflation. According to the results in Table 2, inflation levels in fixed rate systems are 2.31 to 3.07 percent lower than in the intermediate rate system. On the other hand, flexible rate regimes experience 5.47 to 6.44 percent higher inflation in comparison with intermediate

regimes. The finding in Kamin (1997) that in Latin America, attempts to maintain the real exchange rate at a highly depreciated level are more likely to lead to higher inflation than in the case of Asian countries, is confirmed by the results in our study.[6] These results are very indicative of the inflationary process in the different exchange rate systems and robust across the different specifications. It can be derived from the results in this study that policymakers in fixed rate systems are better off in terms of conducting exchange rate policies to achieve the often conflicting goals of controlling inflation and maintaining external competitiveness.

SUMMARY AND CONCLUDING REMARKS

It is argued in the literature that flexible exchange rate regime is preferred to fixed regimes on the ground that it helps to insulate the domestic economy from external adverse shocks by enabling the monetary authorities or the markets to respond quickly to unforeseen and fundamental disturbances. Yet, it is difficult to reconcile this conclusion with the observation that many developing countries prefer the built-in discipline of a fixed exchange regime and the low cost the system entails as a result of lower exchange rate uncertainty.

Our paper specifically explored inflation performance across different exchange rate arrangements in developing countries. First, in order to accurately measure the inflation impact of exchange rate regimes and to address the growing concern in the recent literature, the question of whether the *de jure* classification of exchange rate regimes reflects the actual country practice was addressed. The empirical work in this paper is based on the *de facto* classification of exchange rate regimes obtained by using different methodologies to assess the volatility of the observed nominal effective exchange rates. The empirical work on the linkage between exchange rate regimes and inflation was then undertaken by developing and estimating an expanded version of the conventional Philips curve model.

In general, the results imply that the sources of inflation are quite diverse in developing countries. The findings are that differences in inflation rates across developing countries correspond to differences in the exchange rate regimes adopted by those countries and that inflation inertia, foreign inflation, and the extent of openness to foreign trade, contribute to inflationary pressures in the domestic economy. Two major conclusions are reached on the basis of the results reported in this paper: (1) the rate of inflation is unambiguously positively linked to real exchange rate depreciation regardless of exchange rate arrangements and, more specifically, (2) that the rate of inflation is much more responsive to the real exchange rate levels in the flexible rate systems than in the fixed regimes, suggesting that the former is more inflationary. The first major conclusion underscores the difficulty for a country to simultaneously maintain a reasonable degree of price stability and export competitiveness. The second conclusion however suggests that, unlike countries under flexible exchange rate regime, countries with fixed rate arrangements may be able to maintain a reasonably low inflation while ensuring an adequate external competitiveness and export growth.

The empirical work presented in this paper makes it clear that fixed rate system is less inflationary. The credibility gains in this system and the resulting low inflation environment must however be weighted against the loss of flexibility and possible decline in GDP due to the country's inability to adequately respond to the external shocks, which may lead one to assert that, choosing to peg may not necessarily lead to a welfare gain for the country. However, and as predicted by the results in this paper, a decision to peg may put the country on a better footing in terms of inflation performance.

ENDNOTES

1. Although inflation is lower in most countries in the last decade, it still remains a serious threat, especially in the developing world. There is little disagreement among economists that high inflation is detrimental to an economy. Periods of high inflation (or hyperinflation) are usually associated with lower productivity and poor economic growth. There is also an emerging view that even moderate inflation is detrimental to an economy. Bleaney (1999) showed that a strong negative correlation has emerged in recent years between

inflation and per capita GDP in developing countries. According to Savvides (1995), a 10 percent increase in the average annual inflation rate depresses average annual GDP per capita growth by 0.4 percent across Africa, while Fisher (1993), based on cross-national comparison, found that a 1 percentage point increase in the rate of inflation is, on average, associated with more than 0.1 percent fall in growth rate. Other studies however, point at the more controversial nature of the real output effects of inflation. They claim that not all levels of inflation are bad, and that little (low but positive) inflation may be desirable as it may "grease the wheels" of the economy and monetary policy. For Bruno (1995), the real output cost of lower inflation is only marginal, while growth rates decline steeply as inflation rates approach 25-30 percent. The truly dangerous inflations, he found, occur at rates of 40 percent and above. In the same vein, Sarel (1996) and Bruno and Easterly (1998) found that the real output costs of low-to-moderate inflation are not important, and that only very high levels of inflation have significantly negative effects on economic growth.

2. Although the cutoff points (±2% and ±5%) are arbitrarily chosen by the authors, they are dictated by the structure of the data.
3. For these estimations, only the polar cases (fixed and flexible regimes) are considered).
4. It is important to note that the use of IV instead of OLS did not considerably change the results under OLS.
5. Similar claim was raised by Klau (1998).
6. See the last two columns of Table 2.

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